195-110180C-11/88

MKS

Instruction Manual

TYPE PDR-C-1C/2C POWER SUPPLY DIGITAL READOUT

SIX SHATTUCK ROAD, ANDOVER, MASSACHUSETTS 01810 (508) 975-2350 TELEX 910-240-8005 FAX (508) 975-0093

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SECTION 1

GENERAL DESCRIPTION

The PDR-C-1C and PDR-C-2C are power supply and digital readouts which are packaged in standard half-rack mount units. The PDR-C-2C is designed to provide power for, and accept the outputs from two pressure sensors. The PDR-C-1C is identical to the -2C except the -1C is designed for operation with one pressure sensor.

The power supply for both the -1C and -2C is capable of providing ±15 VDC at up to 600 MA. This will provide enough power for two MKS Baratrons TYPE 222B, 227A, 221, 224, 220B, 223B, or for any electronic manometer with similar input requirements.

The unit contains two setpoint-operated, single pole relays which may be controlled by either pressure channel in the -2C. Setpoint adjustment is accomplished by front panel COARSE and FINE controls which cover the entire range of the gauge in use. The relays' status is indicated by front panel lamps. "Failsafe" relay operation is standard, i.e. the relays are not energized at pressures higher than the setpoint settings. The relays can be latched in the energized state by means of an external logic line to the rear panel interface connector.

The readout is a 4 1/2 place digital panel meter which indicates the output of the attached pressure sensor(s). Engineering units for the readout (mmHG,PSI,etc.) can be selected by a front panel switch. The meter also reads the current setpoint values in the same engineering units by means of another front panel switch. The PDR-C-2C has an additional front panel switch which is used to select display of channel 1, display of channel 2, remote channel selection, or automatic channel selection. In automatic channel selection, the PDR-C-2C will display Ch.1 sensor as long as it is less than 100%. If Ch.1 is greater than 100%, Ch. 2 will be displayed.

SPECIFICATIONS

Mechanical

Package: Standard 1/2 rack size cabinet

Weight: 7 lbs.,3.2 kg

Environmental

Max. Operating Temperature: 50 deg C (122 deg F)

Interface

All inputs/outputs and power supply are available on terminal blocks and other rear mounted connectors.

Electrical

Power Consumption:	65 Watts, full load
Operating Voltage:	117/234 ±15%, 50-60 Hz.
Power Supply Outputs:	±15 volts @ 600mA, max ripple less than 10 mv.
Analog DC Outputs:	0-10 VDC into 10K ohms or greater, 0-1.999 VDC scaled output into 10K ohms or greater.
Display:	4 1/2 place, 7 segment planar LED, red.
Meter Accuracy:	.01% of reading ±1 digit.
Input Impedance:	900K ohms
Zero Adjustment Range:	±1.5% of full scale.

SPECIFICATIONS
(Continued)

Setpoints

Setpoint Relay Configuration:	2 separate circuits, on PDR-C-2C can be connected to either pressure channel with rear mounted toggle switches.
Contact Configuration:	Single Pole Form C (SPDT) brought out to the rear panel. One for each setpoint.
Contact Rating:	2A @ 28 VDC, 1A @ 120 VAC resistive.
Setpoint Hysteresis:	0.5% of full scale.
Setpoint Adjustment Range:	100% of full scale (coarse and fine).
Relay Control:	Digital Low on relay latch line holds the relay off once it has been de-energized.
BCD Outputs (optional):	Tristate output parallel line BCD (1 TTL load each) TTL and CMOS compatible.

Specifications subject to change without notice.

SECTION 2

INSTALLATION

For information regarding the installation of the pressure gauge, refer to the manual for that specific instrument.

> THE PDR-C-1C/2C MUST BE MOUNTED IN SUCH A MANNER AS TO PROVIDE ADEQUATE AIR CIRCULATION ABOUT THE UNIT.

In some cases the sensor cable attaches to the sensor with bare wires to a terminal block and in other cases the cable attaches to the sensor by a connector. MKS' standard color code for sensor cables follows:

+15 VDC Power Input	Green
-15 VDC Power Input	White
Pressure Input	Red
Power Ground (Return)	Black
Signal Ground (Return)	Black
Chassis (Case)	Black (large)

GROUNDS:

The PDR-C-1C/2C has a three ground system which allows for the separation of the power supply return (D GND) and the DC output signal return (A GND) and the chassis ground. When used with pressure gauges that have only a two ground system, connect the D GND and A GND to that gauge's common ground and then connect the chassis ground of the PDR to the chassis ground of the gauge.

REAR PANEL CONNECTIONS AND CONTROLS
(See Figure 1A and 2A)

A. PRESSURE GAUGE CONNECTOR(S):

These connectors are used to interface the PDR with the pressure gauge(s). They provide power to gauges requiring it, and receive the pressure signal back from the gauge.

B. DECIMAL POINT SELECTOR(S):

These are 4PST rocker switches used to set the display decimal point to the appropriate position for the pressure range being measured. The following chart shows switch settings for various full scale pressure values.

GAUGE F.S.	SWITCH SELECTION			
	1	2	3	4
1MM	ON	OFF	OFF	OFF
10MM	OFF	ON	OFF	OFF
100MM	OFF	OFF	ON	OFF
1000MM	OFF	OFF	OFF	ON
10000MM	OFF	OFF	OFF	OFF

Note: Closure of more than one switch (per channel) will produce multiple decimal points and interaction between channels.

C. POWER INTERFACE CONNECTOR

This module accepts a standard power cord, and contains a line fuse, filter, and input voltage selector. The selected line voltage is visible on a small PC board mounted behind the plastic window. To change this voltage proceed as follows:

1. Remove the line cord and slide the plastic window to the left.

2. Pull the fuse lever outward to eject the fuse.

3. Insert a small probe in the hole in the PC card and remove the card.

4. Position the PC board so that the voltage desired is readable from the rear.

5. Plug the card back into the module, insert the proper value fuse (1 ASB @ 120 VAC or 1/2 ASB @ 240 VAC), slide the window to the right and plug in the line cord again.

D. INTERFACE CONNECTOR (J118)

This 20 pin connector is used for external access to the PDR. Set point relay connections (NC,NO,COMMON) are available on the connector as well as 0-10 volt full scale analog outputs which are equal to the incoming pressure signal including zero correction. Also available on this connector are the LATCH control lines used to remotely hold the setpoint relays in the energized state, and a 0-1 volt analog output voltage line whose voltage is equal to the front panel display DVM input voltage. Analog and digital grounds are also brought out. The PDR-C-2C uses three additional lines; two for identification of which channel is currently being displayed and one line for remote selection of which channel is to be displayed. See Appendix 5-1 for the pinout of this connector.

E. BCD OUTPUT CONNECTOR (optional)

This connector provides 5 volt BCD logic lines directly from the front panel DVM. It is used for remote pressure reading and it outputs the same quantity as shown on the DVM. The BCD lines are updated approximately every .5 seconds, as is the display.

F. SETPOINT CHANNEL SELECT SWITCHES (PDR-C-2C only)

These switches are used to select which pressure signal is applied to each of the two setpoint comparators.

FRONT PANEL CONTROLS AND INDICATORS
(See Figures 2A and 2B)

G. POWER SWITCH

Applies power to the PDR.

H. DISPLAY DVM

A 4 1/2 place voltmeter which accepts 1.9999 volts full scale. This meter contains its own power supply, and provides display information in BCD form to the rear panel. Decimal point information for the display is obtained from rear panel range rocker switches and internal decoding circuits used in conjunction with the engineering units switch.

I. ZERO ADJUST CONTROL

These controls are used as fine zero adjustments for the pressure gauge. An absolute pressure gauge must be pumped down below its resolution before this adjustment can be made; differential gauges should be cross-ported. The zero control on the pressure sensor is used as a coarse zero.

J. SETPOINT ADJUST CONTROLS

These controls are used to adjust the desired setpoint level. Range is from 0 to 100% of the full scale pressure.

K. READ SETPOINT SWITCH

This switch connects the pressure signal to the engineering units circuit and ultimately to the display when it is in the center position. When it is switched toward one side or the other it connects the appropriate setpoint level through the engineering units circuit to the DVM. Thus the setpoint level is displayed in the same pressure units as the gauge being used. The switch is spring loaded to return to the center position when released.

L. SETPOINT RELAY INDICATOR LAMPS

These LED's are illuminated when the setpoint relay is energized. This will occur when the pressure signal is below the setpoint value.

M. ENGINEERING UNITS SELECTION SWITCH

This rotary switch is used for selecting which engineering units should be used with the front panel display. Changing this switch will automatically scale the display to the right value and move the decimal point to the appropriate location in the display.

N. X10-3 LAMP

This LED indicates when the display is showing units requiring multiplication by 1/1000.

O. CHANNEL SELECT/REMOTE/AUTO SWITCH (PDR-C-2C only)

If set in either the "1" or "2" position, then the chosen channel's pressure value will be displayed (unless the READ switch is used).

If this switch is set to the "AUTO" position, then the display will monitor channel 2 at high pressures (it is assumed that channel 2 is connected to a sensor having higher range) until the pressure reading of channel 1's sensor falls to 90% of its full scale value. The display will continue to monitor channel 1 until channel 1's pressure reaches 100% of full scale of its pressure gauge, at which time it will automatically switch to monitoring channel 2.

If set for the "REMOTE" position, then an external 5 volt logic line may be used to select either channel 1 or 2 to be displayed. If a high signal is sent to this line, or if left unconnected, channel 1 will be selected. A low signal voltage will select channel 2.

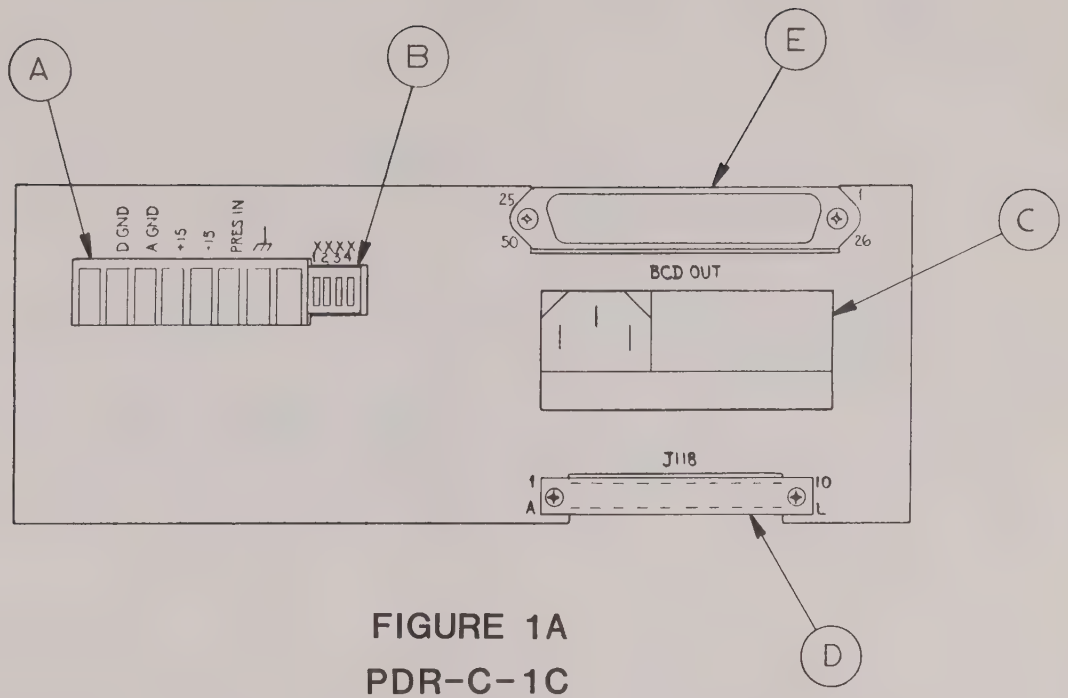


FIGURE 1A
PDR-C-1C

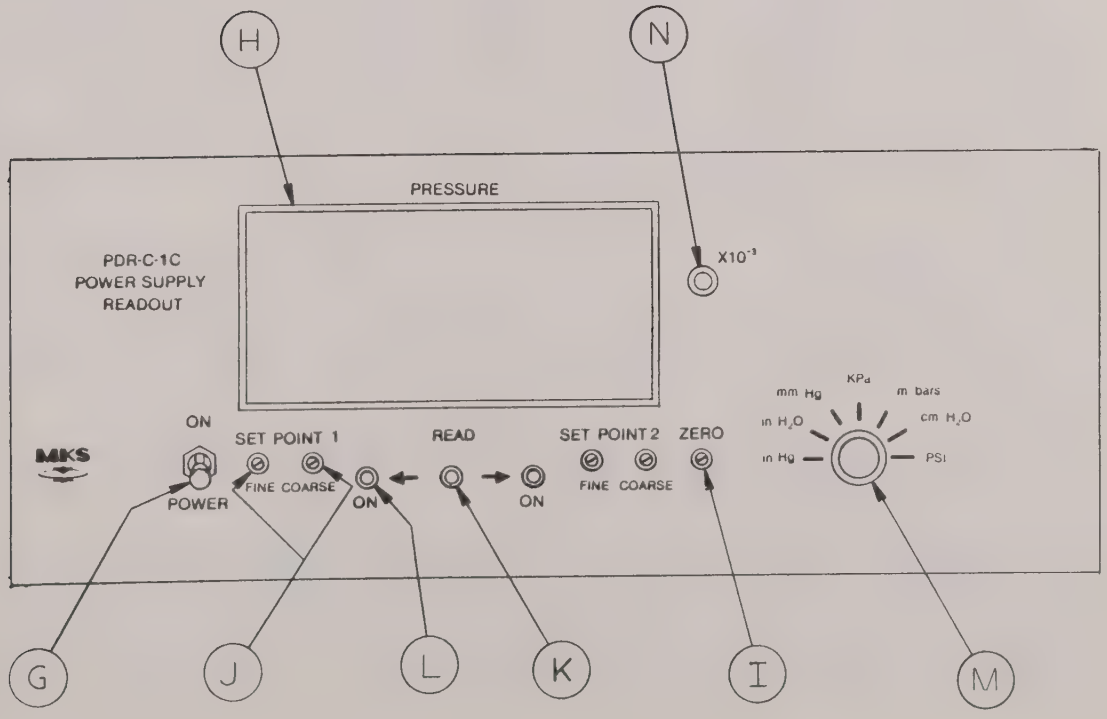


FIGURE 1B
PDR-C-1C

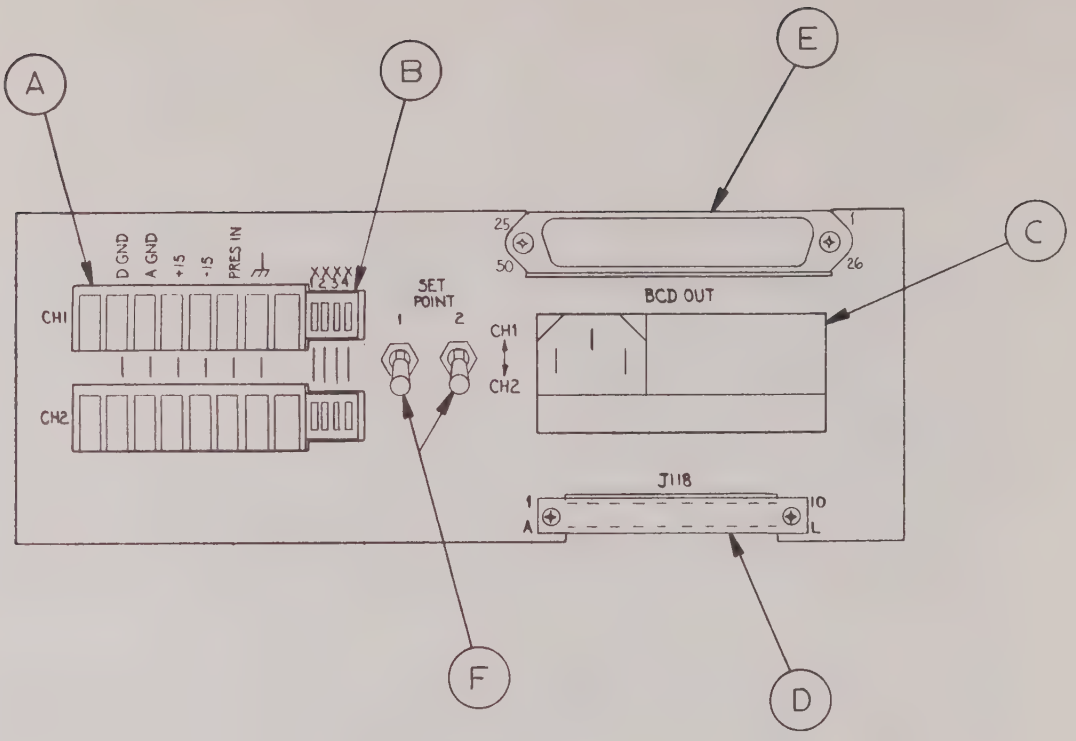


FIGURE 2A
PDR-C-2C

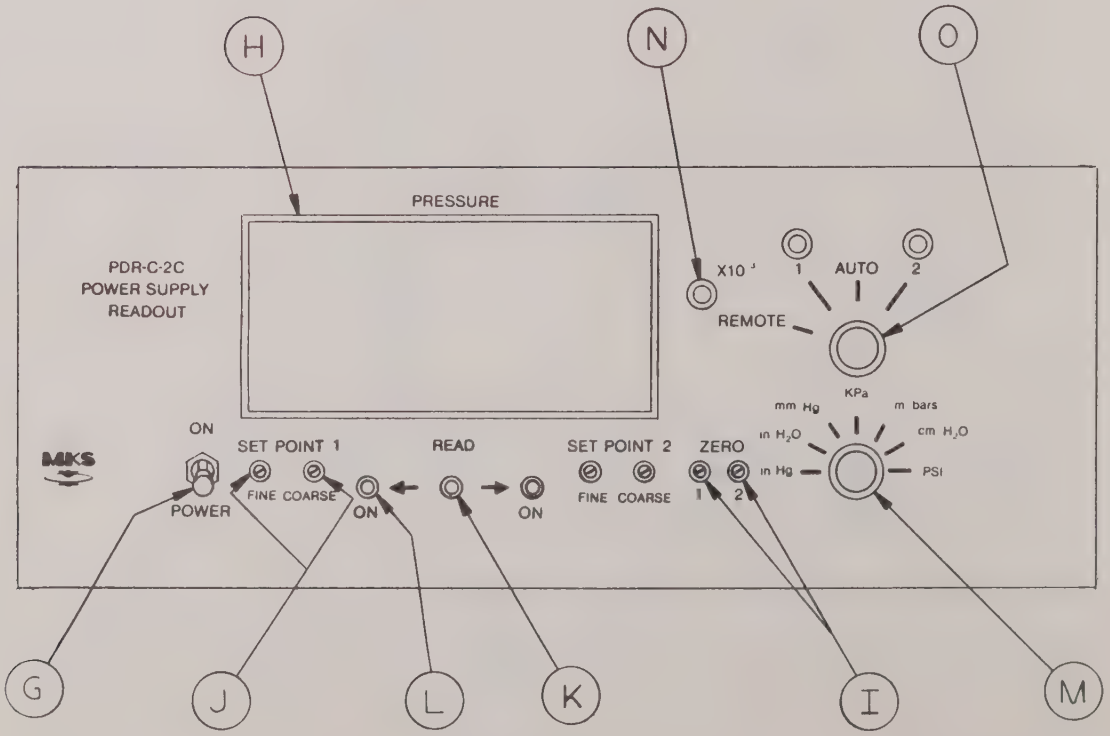


FIGURE 2B
PDR-C-2C

THEORY OF OPERATION
(Refer to Figure 3 and Schematic)

PRESSURE SIGNAL

The pressure signal is received from the pressure gauge at the rear panel terminal block and is applied to the input amplifier (U1) where the fine zero correction is added. The output from this amplifier then goes to the output buffer amplifiers (U2,U3) and to the rear panel interface connector. The output from U1 also goes to the set point switching circuits (through the rear panel Channel Select switches on the PDR-C-2C) and to the Engineering Units scaling circuit (through the DVM selection relay on the PDR-C-2C) which leads ultimately to the display DVM.

SET POINTS

Two independant set point relays and their respective switching circuits are included in both the PDR-C-1C and -2C. In the -2C these set points can be selected to monitor either incoming pressure signal by means of rear panel channel selection switches. The set point circuit (U20,U16,U17,U18 and U19) compares the incoming pressure signal with an adjustable reference voltage which is set using the front panel Coarse and Fine adjustment controls. The relay logic is such that a no-power condition produces the same relay states that a high-pressure situation will produce. Either set point value may be read on the display DVM in engineering units by toggling the front panel READ switch toward the appropriate side. Asserting either LATCH line on rear panel connector J118 will hold the setpoint relays de-energized once that state has been reached.

OVER RANGE COMPARATOR

This circuit (U15) monitors the input to the engineering units circuit and causes the display to blank when a pressure signal of approximately 11 or more volts occurs.

POWER SUPPLY

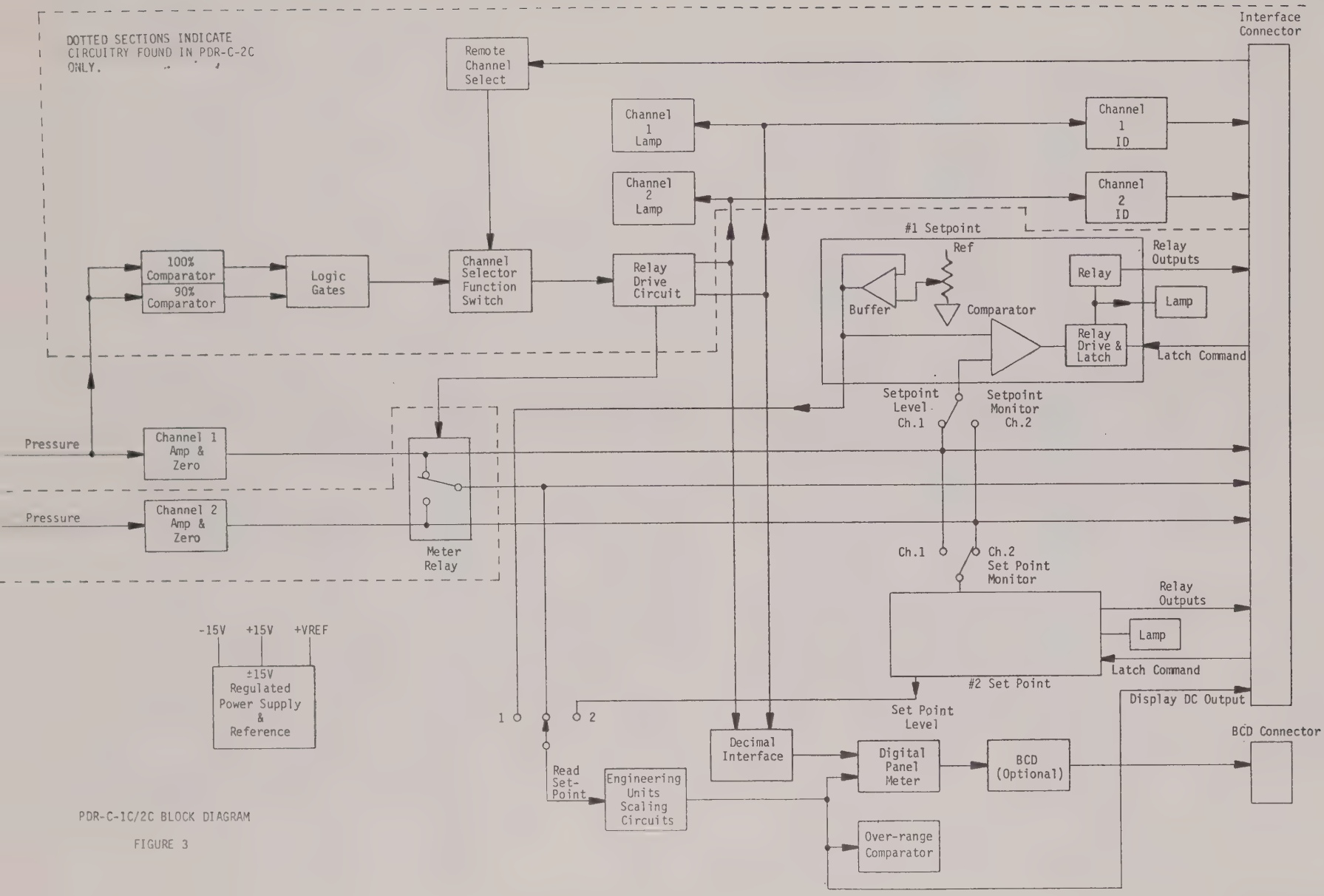
The power supply provides ±15 volts for internal circuits as well as for the attached pressure gauge. The + and - supplies are identical and are internally protected against shorts and overheating. This supply also generates the precision reference voltage used by the comparators. The display DVM provides its own +5 volt source which is also used as the supply for 5 volt logic on the main PC board.

PRESSURE LEVEL COMPARATORS (PDR-C-2C only)

The channel 1 pressure signal is applied to two comparators (U4). One of these is set to trip at 90% of full scale pressure while the other is set for 100%. The comparator outputs are connected to logic whose output goes to the front panel Channel Selector/ Function Switch.

Channel Selector/Function Switch (PDR-C-2C only)

This switch is used to determine which channel's output is displayed by the front panel DVM by choosing which logic level or input is applied to the channel select relay (K1). If the AUTO switch position is chosen then the logic output from the pressure level comparators is applied to the relay switching transistor (Q1). Front panel LEDs are used to indicate which channel is being displayed. When the Channel Selector/Function Switch is set to the REMOTE position the user can remotely select which channel is being displayed by inserting the appropriate logic level on pin C of the rear panel interface connector.



PDR-C-1C/2C BLOCK DIAGRAM

FIGURE 3

SECTION 4
MAINTENANCE AND TROUBLESHOOTING

GENERAL

Should any difficulties be encountered in the use of your instrument, it is recommended that you contact any authorized MKS Sales Office or the Home Office for repair instructions.

If it is necessary to return the instrument to MKS for repair, please contact MKS' Customer Service Dept. at the Home Office for an ERA number (Equipment Return Authorization), to expedite handling and assure proper servicing of your instrument.

Should it become necessary to attempt repair in the field, the first step is to isolate the source of the problem to the pressure gauge or the PDR. Any repair made to the pressure gauge will usually require a recalibration. The PDR-C-1C/2C may be repaired without recalibration as long as none of the calibration adjustments have been tampered with.

FAULT ISOLATION

The first step in troubleshooting is to isolate the problem to one of the sections of the PDR. Once this is done the problem can usually be easily located and corrected. The PDR-C-1C/2C can be broken down into the following sections:

A. Power Supply
B. Pressure Signal Amplification and Readout
C. Set Point Circuits
D. Channel Selection Circuits (PDR-C-2C only)

Since a problem in the power supply will effect the performance of all sections, it's important to begin fault isolation at this point.

A. Power Supply

Measure the $\pm$15 volt supplies on the rear panel pressure gauge connector with respect to P GND. The voltages should be within the range of 14.8 to 15.2 volts and the AC ripple should be less than 10 mV P-P. If the voltages appear to be normal, then proceed to check the next section. If supply voltages are found to be not normal, disconnect the pressure gauge and retest the supply voltages. If the supplies now appear to be normal, the fault is with the pressure sensor. If the supplies are not normal after removing the pressure sensor, then remove the power supply jumpers (E1-E2 and E3-E4) in order to isolate the power supply from the rest of the PDR circuits. If the supplies now are normal, then the fault is probably a short circuit in the PDR circuits. If the supplies continue to appear abnormal, then refer to the schematic and continue to troubleshoot down to the component level.

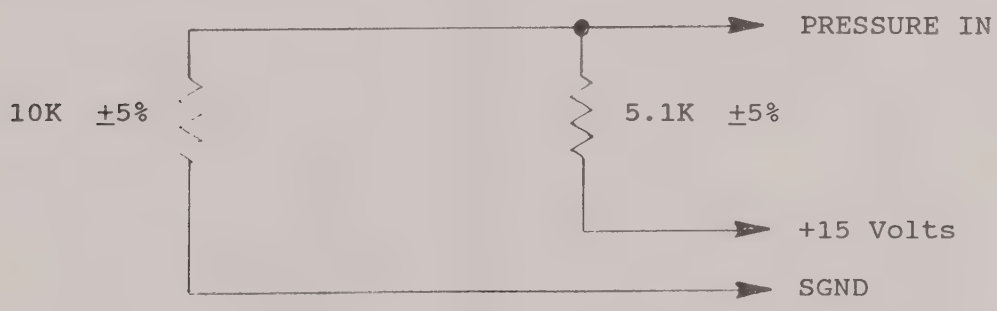
B. Pressure Signal Amplification and Readout

Set up the PDR so that it is displaying the output in mmHg from a connected pressure gauge. At the rear panel terminal block, connect an external voltmeter between Signal GND and the Pressure Input. If this voltage closely tracks* (±.2 V) the voltage that is displayed on the front panel DVM but is not representing the correct pressure, then the pressure gauge is in error and the PDR is normal. If the voltage doesn't track then proceed.

* A voltage of above approximately 10.8 volts will cause the digital panel meter to overrange and blank. This is to be considered normal.

To troubleshoot the signal path of the PDR-C-1C/2C, disconnect the pressure gauge and replace it with two resistors connected in the following manner:

(Connect to Channel 1 and place channel selector to Channel 1 in the PDR-C-2C).



This will produce an input voltage of +9.6 to +10.3 volts. To produce a zero input, simply short out the 10KΩ resistor. Set the front panel engineering units switch to the "mmHG" position. Use an external meter to measure the output voltage for this channel(not the "DC OUTPUT"). Reference the meter to SGND on the input con-nector. The output voltage should track the input voltage developed by the above network to within ±.2 volts. If not then the problem lies in the channel amplifier and zero circuit. Refer to the schematic and the circuits involving U1,U2 and U3 in order to troubleshoot to the appropriate component. If the voltage does track but the front panel DVM does not agree, the problem is with either the engineering units resistive divider (R43-R54), relay K1 (PDR-C-2C only), the front panel READ or engineering units switch, or buffer U8. Note that the DVM is 1.9999 volts full scale and will read out 1/10 of the incoming signal voltage when set to the "mmHG" position (ignoring decimal point).

1. Calibration of Engineering Units Circuit

Equipment Required:
1 DVM, 5 1/2 place
1 Precision Variable Voltage Source, 10 volt
Misc. Bus Wire
Schematic
PC Layout

With power off, short the Pressure Input to the Signal GND terminal on the PDR rear panel terminal block (CH 1). Attach the DVM between Analog GND and the zeroed CH 1 signal available at front panel switch S3 or at one end of R43. Apply power to the PDR and adjust the front panel ZERO trimmer for a 0.000±.0005 volt DVM reading. Shut off power to the PDR and attach the voltage source between the Pressure Input and Signal GND terminals. Apply power and a voltage source of 10.0000 ±.0005 volts, as measured by the DVM. Ignoring the decimal point on the front panel display, use the following chart to set the appropriate trimmer for a correct display of the chosen engineering units.

UNITS	TRIMMER	FRONT PANEL DVM
PSI	R44	19337
cmH2O	R55	13597
mbar	R47	13332
KPa	R47	13332
mmHG	R49	10000
inH2O	R51	5353
inHg	R53	3937

C. Setpoints

With the input section zeroed and 10 volts input applied as described above in "Calibration of Engineering Units" (place PDR-C-2C rear panel SETPOINT switches in "CH 1" position), check voltages at U20 pin 5 and U16 pin 3 to be 10.000 volts. If not, check continuity from R5 and R6 through jumpers E7-E8 and E9-E10 (PDR-C-1C) or through rear panel switches S7 and S8 (PDR-C-2C).

If 10 volts is read at U20 and U16 then check the voltage at U20 pin 3 and verify it with the front panel DVM, with engineering units set to "mmHG". Do this by moving the front panel SETPOINT switch to the left for CH 1. Similarly check U16 pin 5 to be the same as the front panel display with the SETPOINT switch to the right (CH2). Varying the COARSE and FINE setpoint trimmers should vary the display voltages accordingly.

By changing the incoming "pressure" signal from the voltage source to be close to the the setpoint voltage, the outputs of both setpoint comparators (U18A pin 1 and U18B pin 7) should switch between the positive and negative supply rails. This in turn should cause U17 pins 10 and 4 to vary inversely between 0 volts and the positive supply (be sure the LATCH lines are in a high state-U17 pin 12 and pin 1). Next check the outputs from U19 pins 1 and 7 to ensure switching between rails. If the above all works, any problem must be with the relay drivers Q5 and Q6 or relays K2 and K3 and associated components.

D. Channel Selection Circuits (PDR-C-2C only)

If no channel selection is indicated, check J113 pin 2 to be connected to digital ground and J113 pin 1 to be +5 volts. If digital ground is at fault, check continuity back to the power supply. If +5 volts is at fault, check wiring from the front panel DVM (+5 volt supply comes from the DVM!). If both are O.K. and no channel switching occurs, check the collector voltages of Q1 and Q2 to verify that one is at 0 volts and the other is at +15 volts. If this is O.K. check that relay K1 is switching when changing channel selection from CH 1 to CH 2 and back. If remote channel selection malfunctions, check U6 pin 4 to be switching inversely to an applied +5 volt logic signal on rear panel connector J118 pin C.

If problems exist with the AUTOmatic channel selection circuit, first select AUTO operation and attach the voltage source to channel 1 Pressure Input as previously described. While monitoring the voltage at U4 pin 1, vary the incoming voltage from approximately 8 volts up to 11 volts noting that U4 pin 1 should switch high at approximately 10 volts input. If not, check circuit or adjust R16. Next do the same test while monitoring U4 pin 7, noting that switching should occur with approximately 9 volts input. If this all checks out, next measure U5 pin 4 to be switching high at approximately 10 volts as the input increases from 8 volts. Next decrease from 11 volts and note U5 pin 4 to be switching low as the input voltage equals approximately 9 volts. If this is happening and automatic channel selection is not occuring, then the relay (K1) driver circuits are at fault.

SECTION 5

APPENDIX

Remote Channel Select/Setpoint Interface Connector (J118)

Pin #	Description
1	Signal GND
2	Digital GND
3	N/C
4	Switched DC Output (in engineering units)
5	N/C
6	Latch #2 Setpoint Relay (active low)
7	Latch #1 Setpoint Relay (active low)
8	Setpoint #1 Relay NO Contact
9	Setpoint #1 Relay NC Contact
10	Setpoint #1 Relay C Contact
A	Channel 1 Range ID (*see note below)
B	Channel 2 Range ID (*see note below)
C	Remote channel Select
D	N/C
E	N/C
F	CH 2 DC Output (0-10 volts,zero corrected)
H	CH 1 DC Output (0-10 volts,zero corrected)
J	Setpoint #2 Relay NC Contact
K	Setpoint #2 Relay NO Contact
L	Setpoint #2 Relay C Contact

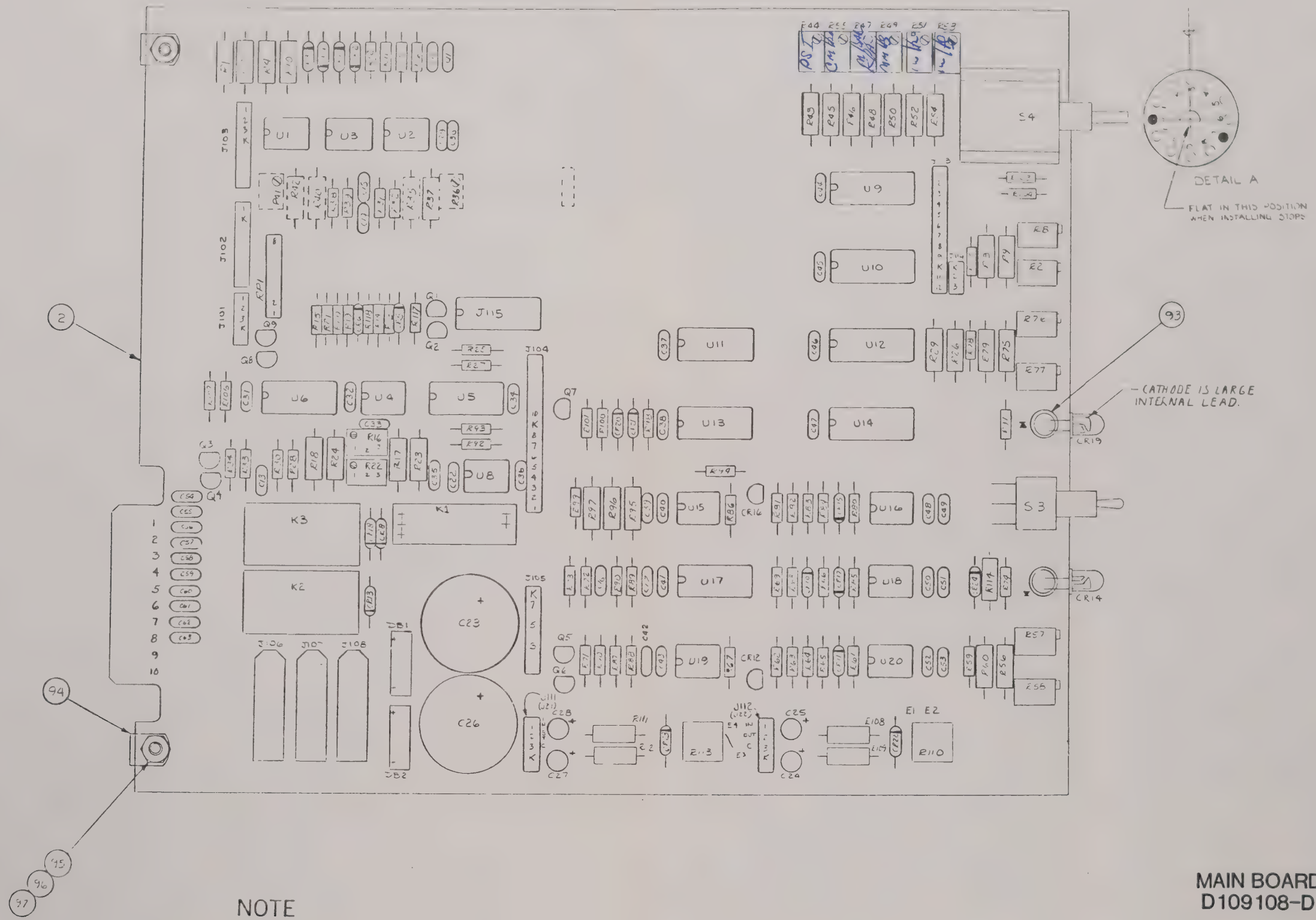
* Transistor open collector will sink 10ma @0.4 volts. Maximum off voltage (VCEO) is 25 volts.

BCD OPTION

This option provides a latched and buffered BCD output at the rear panel.The BCD information is enabled or disabled by six control lines. When these lines are tied together and connected to digital ground all of the BCD information is present at the rear connector and can be read when the DATA READY goes high. When these lines are open then all of the BCD lines are open. This is done so that several meters can be connected to a common bus and strobed for a reading by grounding the appropriate control lines. The BCD outputs can be interfaced to a computer or digital printer. The pinout of the rear panel connector is shown below.

BCD DATA		PIN#	BCD DATA	PIN#
1		8	10000	5
2	DIGIT 1	36	POLARITY (+)	27
4		38	OVERRANGE	26
8		40	ENABLE DIGIT 5	31
	ENABLE DIGIT 1	17	ENABLE REMAINDER	34
10		16		3
20	DIGIT 2	14	DIGITAL COMMON	28
40		12		4
80		35		
	ENABLE DIGIT 2	7	DATA READY	30
100		10	+3P	22
200	DIGIT 3	11	+2P	23
400		13	+1P	44
800		42	0P	45
	ENABLE DIGIT 3	41	-1P	47
			-2P	48
1000		15		
2000	DIGIT 4	39		
4000		37		
8000		33		
	ENABLE DIGIT 4	32		

NOTE: THE BCD CONNECTOR PINOUT FOR THE PDR-C-1C/2C IS COMPLETELY DIFFERENT FROM THE PREVIOUS BCD PINOUTS OF EITHER THE PDR-C-2 OR THE PDR-C-1B.AS A RESULT, CABLING WHICH IS COMPATIBLE WITH PREVIOUS PDR'S WILL NOT WORK WITH THE PDR-C-1C/2C.



NOTE

THE FOLLOWING COMPONENTS ARE FOR SPECIAL APPLICATION ONLY:
R35 R36 R37 R40 R41 R42.

MAIN BOARD
D109108-D

LINE ITEM NO	DWG CODE	IDENTIFICATION NUMBER	QTY G1	QTY G2	ITEM NAME & DESCRIPTION	MFR CODE IDENT	NOTE NO
1	D	109161	REF	REF	SCHEMATIC DWG.		
2	D	109107	1	1	P.C. BOARD		
3							
4		065-2450	(3)	4	RESISTOR 10K ±1% RN60 (R. R.3, R79) R7		
5		065-3155	(2)	4	RESISTOR 909K ±1% RN60 R2,4,5, C		
6		065-4389	-	1	RESISTOR 1.21K ±1% RN60 R17		
7		065-3207	-	1	RESISTOR 9.76K ±1% RN60 R18		
8		065-4345	4	4	RESISTOR 909Ω ±1% RN60 R56,75 107, 112		
9		065-2555	2	2	RESISTOR 4.02K ±1% RN60 R95, 97		
10		065-4349	1	1	RESISTOR 22.1K ±1% RN60 R96		
11		065-4344	2	2	RESISTOR 90.9Ω ±1% RN60 R108, 111		
12		065-4340	1	1	RESISTOR 255Ω ±1% RN60 R114		
13		064-4553	-	2	RESISTOR 820Ω ¼W R26, 29		
14		064-2582	(5)	7	RESISTOR 150Ω ¼W ±5% R113,138,59, 78, 93, R5)		
15		064-2442	2	2	RESISTOR 300Ω ¼W ±5% R70, 87		
16		065-2993	-	1	RESISTOR 8.87K ±1% RN60 R24		
17		064-4185	2	2	RESISTOR 560K ¼W ±5% R64, 83		
18		064-2428	(5)	7	RESISTOR 1K ¼W ±5% R 13,19(61,62,80,81,94)		
19		064-2585	1	1	RESISTOR 270Ω, ¼W ±5% R105		
20		064-2593	-	3	RESISTOR 5GK ¼W ±5% R25, 106, 107		

MKS INSTRUMENTS, INC. BURLINGTON, MASS 01803 617-272-9255 | PL 109108 | REV B | SH 2

LINE ITEM NO	DWG CODE	IDENTIFICATION NUMBER	QTY G1	QTY G2	ITEM NAME & DESCRIPTION	MFR CODE IDENT	NOTE NO
21		064-2670	(4)	6	RESISTOR 4.7K ¼W ±5% R15(30 73, 90, 100) R21		
22		064-3104	2	2	RESISTOR 390Ω ¼W ±5% R74, 91		
23		064-2591	2	2	RESISTOR 3.3K ¼W ±5% R71, 88		
24		064-2439	(2)	4	RESISTOR 15K ¼W ±5% R35, 34, (47, 86)		
25		064-2057	(5)	8	RESISTOR 10K ¼W ±5% R(6,12,27,(32),39,68,69,92)		
26		064-2051	8	8	RESISTOR 47K ¼W ±5% R28,65,66,72,84,85,89,101		
27		064-4051	2	2	RESISTOR 470K ¼W ±5% R98, 99		
28		064-2559	-	2	RESISTOR 1M ¼W ±5% R14, 20		
29		064-2714	2	2	RESISTOR 10M ¼W ±5% R82, R63		
30		066-4365	1	1	RESISTOR 80.63Ω ±0.5% (PREC WW) R93		
31		066-4885	1	1	RESISTOR 4754Ω ±0.5% (PREC WW) R45		
32		066-4075	1	1	RESISTOR 500Ω ±0.5% (PREC WW) R46		
33		066 4361	1	1	RESISTOR 2833Ω ±0.5% (PREC WW) R48		
34		066-4363	1	1	RESISTOR 4297Ω ±0.5% (PREC WW) R50		
35		066-4360	1	1	RESISTOR 1216Ω ±0.5% (PREC WW) R52		
36		066-4362	1	1	RESISTOR 3837Ω ±0.5% (PREC WW) R54		
37		065-2803	-	1	RESISTOR 2.21K ±1% RN60 R23		
38		064-2518	2	2	RESISTOR, 150K, ¼W 5% R103, R104		
39							
40							

MKS INSTRUMENTS, INC. BURLINGTON, MASS 01803 617-272-9255 | PL 109108 | REV D | SH 3

LINE ITEM NO	DWG CODE	IDENTIFICATION NUMBER	QTY G1	QTY G2	ITEM NAME & DESCRIPTION	MFR CODE IDENT	NOTE NO
41		053-4195	2	2	POT 500Ω, TOP ADJ R47, 49		
42		053-4131	2	2	POT 200Ω, TOP ADJ R51, 53		
43		053-4314	(3)	4	POT 10K, END ADJ R(2,8,(57, 76)		
44		053-4199	(1)	3	POT 1K, TOP ADJ R16, 22, (44)		
45		053-4538	1	1	POT 20K, TOP ADJ R55		
46		053-4346	2	2	POT 200Ω, 1 TURN R110, 113		
47		053-4263	2	2	POT 500Ω, END ADJ R58, R77		
48		015-2595	2	2	DIODE 1N5059 CR22, CR23		
49		015-2412	(18)	15	DIODE 1N414B (CR1,2,3,4,5,6,8,10,(13,15,17,18,20,21)		
50		016-4347	1	1	DIODE 1N 942 CR24		
51		015-4548	2	2	DIODE BRIDGE MDA 102A DB1, 2		
52		015-4171	2	2	DIODE MSD 6150 CR12 16		
53		044-4101	2	2	LED, GREEN CR 19, 19		
54							
55							
56		005-3259	(40)	43	CAP. .01UF 500V CER C12 C13 C15 C32 C33 C34 (C11-C17, C22 C29, C30, C31), C35-C43)		
57		007-2962	4	4	CAPACITOR 10UF 20V C24, 25, 27, 28		
58		007-4356	2	2	CAPACITOR 2200UF 35V C23, 26		
59							
60							

MKS INSTRUMENTS, INC. BURLINGTON, MASS 01803 617-272-9255 | PL 109108 | REV D | SH 4

LINE ITEM NO	DWG CODE	IDENTIFICATION NUMBER	QTY G1	QTY G2	ITEM NAME & DESCRIPTION	MFR CODE IDENT	NOTE NO
61		082-3274	(1)	7	TRANSISTOR MPS 5172 Q1,2,3,4,(7),8,9		
62		084-4128	2	2	TRANSISTOR 2N2907 Q5,6		
63		069-4565	1	1	RESISTOR NETWORK 47K RP1		
64							
65							
66		030-4273	(6)	7	IC MC1458 (U2,4,15,16,18,19,20)		
67		036-9035	(2)	3	IC 4011B U5,(6,11)		
68		030-5100	(2)	3	IC LT1001 (U2,3,(8)		
69		036-9029	1	1	IC CD4001B U17		
70		037-9003	1	1	IC CD4008AE U9		
71		037-9037	1	1	IC CD 4028AE U10		
72		036-9005	1	1	IC 4023 U13		
73							
74		036-9006	2	2	IC 4049 U12, 14		
75							
76							
77		057-4650	2	2	RELAY K2,3		
78		057-2422	-	1	RELAY K1		
79		072-4880	1	1	SWITCH, ROTARY S4		
80		072-4342	1	1	SWITCH DPDT S3		

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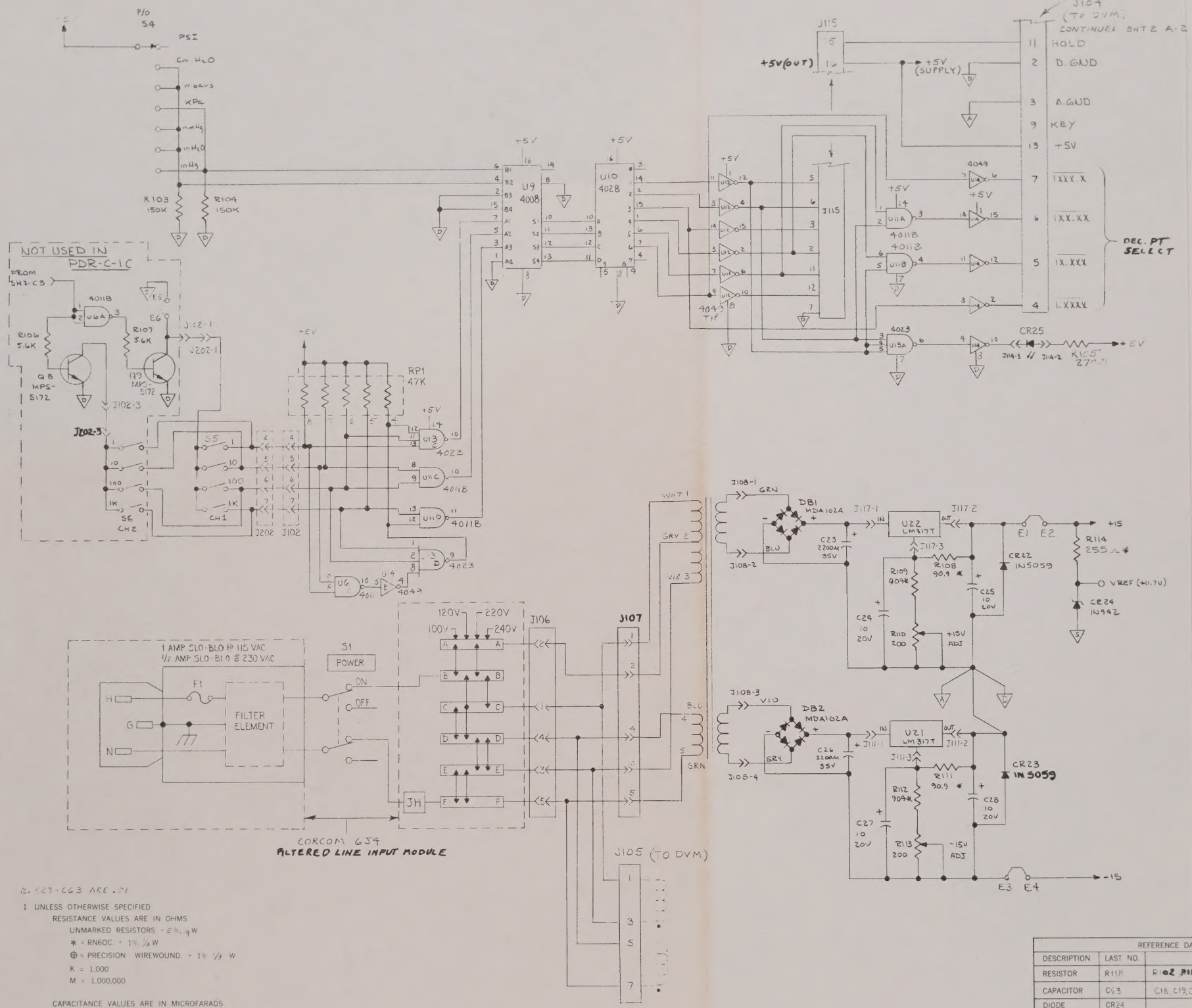
LINE ITEM NO	DWG CODE	IDENTIFICATION NUMBER	QTY G1	QTY G2	ITEM NAME & DESCRIPTION	MFR CODE IDENT	NOTE NO
81		110-3472	1	1	HEADER 15 PIN J104		
82		110-3589	3	3	HEADER 8 PIN J105, 102, 103		
83		110-3473	3	3	HEADER 5 PIN J111, 112, 101		
84		110-3968	1	1	HEADER 12 PIN J113		
85		110-3474	1	1	HEADER 3 PIN J114		
86		156-2788	1	1	DIP SOCKET 16 PIN J115		
87							
88							
89		110-6560	2	2	PIN & SOCKET WAFER J106, 107		
90		110-6042	1	1	PIN & SOCKET WAFER J108		
91		093-2.00	4'	2'	BUS WIRE, 22 AWG		
92							
93		166-2741	2	2	SPACER USE WITH CR14, 19		
94		103-6014	2	2	BRACKET, ANGLE		
95		160-3687	2	2	SCREW PAN MD #4-40 X .25 LG		
96		185-3744	2	2	WASHER INT TOOTH LOCK #4		
97		146-3753	2	2	NUT HEX #4-40		

MKS INSTRUMENTS, INC. BURLINGTON, MASS 01803 617-272-9255 | PL 109108 | REV B | SH 6



2. C23-C28 ARE +5V

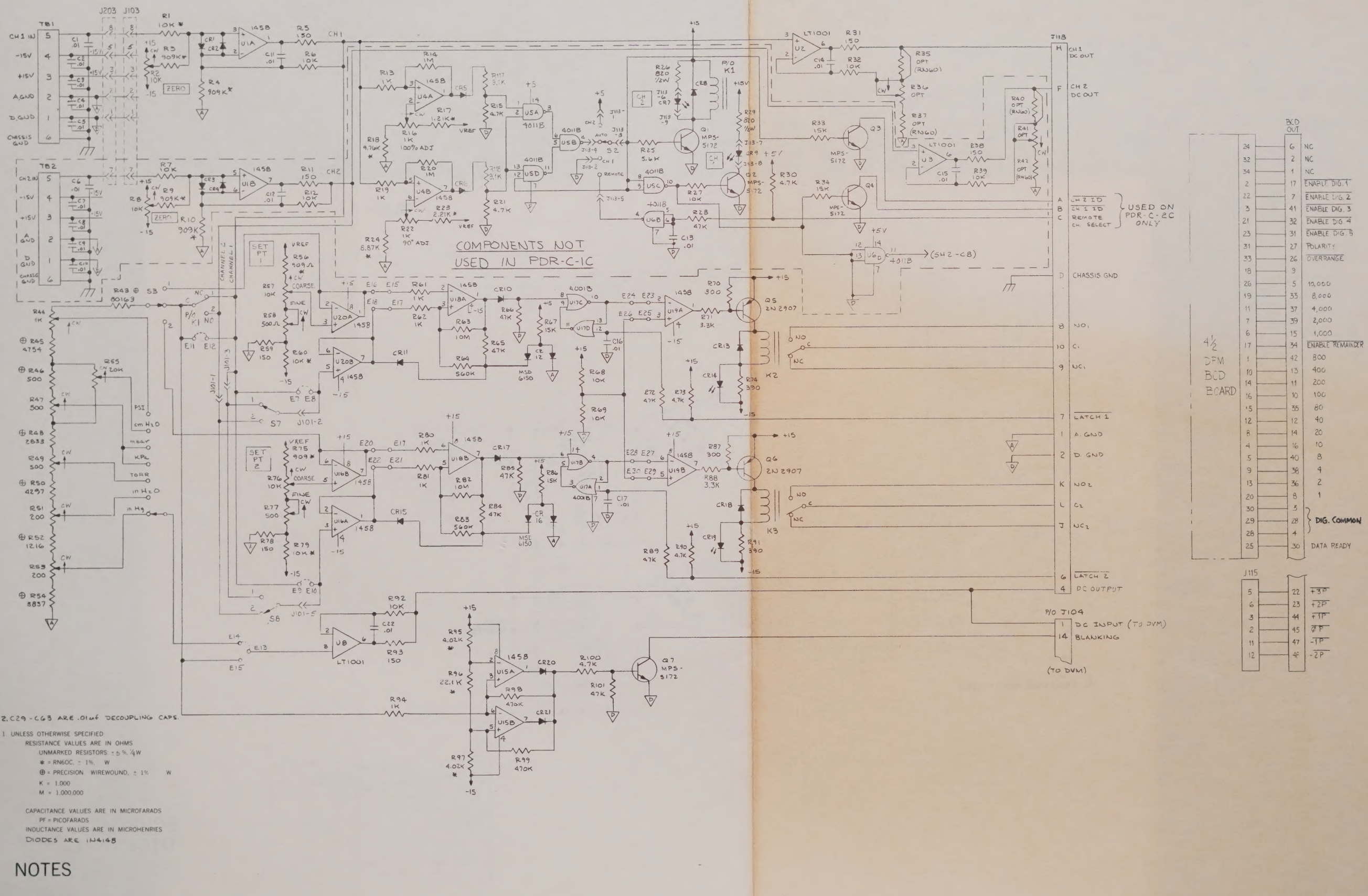
1 UNLESS OTHERWISE SPECIFIED
RESISTANCE VALUES ARE IN OHMS
UNMARKED RESISTORS ± 5%, ¼W
* = RN60C, ± 1%, ⅛W
⊕ = PRECISION WIREWOUND, ± 1%, ½ W
K = 1,000
M = 1,000,000

CAPACITANCE VALUES ARE IN MICROFARADS
PF = PICOFARADS
INDUCTANCE VALUES ARE IN MICROHENRIES
DIODES ARE IN4148

NOTES

REFERENCE DATA		
DESCRIPTION	LAST NO.	DELETED NOS.
RESISTOR	R118	R102, R115, R116
CAPACITOR	C43	C18, C19, C20, C21
DIODE	CR24	
TRANSISTOR	Q9	
IC	U22	

SCHEMATIC
D109161-E



2. C29 - C63 ARE .01uf DECOUPLING CAPS.

1. UNLESS OTHERWISE SPECIFIED
   RESISTANCE VALUES ARE IN OHMS
   UNMARKED RESISTORS: ± 5% ¼W
   * = RN60C, ± 1%, W
   ⊕ = PRECISION WIREWOUND, ± 1% W
   K = 1,000
   M = 1,000,000

   CAPACITANCE VALUES ARE IN MICROFARADS
   PF = PICOFARADS
   INDUCTANCE VALUES ARE IN MICROHENRIES
   DIODES ARE 1N4148

NOTES

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